Brainwave - A Report Based on Creating An App for Learning

Syed F. Shah

University of Sussex, 2023

Word Count: 2787

Abstract

This report describes the design process for a Technology-Enhanced Learning Environment (TELE) in the form of a novel smartphone application called Brainwave, which seeks to provide comprehensive computer technology education. Brainwave offers an immersive, interactive, and engaging learning experience for users of all skill levels, covering topics ranging from tangible components to theoretical concepts such as electronics and programming.

Firstly, it begins with a discussion of the concept's theoretical foundations, drawing from various educational and cognitive theories to support Brainwave's pedagogical approach. The section then delves into the design and development phases, describing the iterative process that included user-centric design, prototyping, and testing to create an effective and user-friendly application. The report also emphasizes Brainwave's innovative features and functionalities, such as adaptive learning, gamification, and personalized feedback, which distinguish it from conventional learning methods.

Finally, it shall conclude by analyzing the potential impact of Brainwave on the educational landscape, highlighting its accessibility, flexibility, and adaptability benefits. This report intends to demonstrate Brainwave as an exemplary model for Technology-Enhanced Learning Environments by providing a comprehensive comprehension of the design process, thereby paving the way for future innovations in digital education.

Keywords: **Brainwave, TELE, App, educational, cognitive theories, design, innovation**

Contents

Introduction

Rapid technological advancements and the growing significance of computer literacy have emphasized the need for effective educational strategies that cultivate a comprehensive comprehension of computers and technology[1]. Traditional approaches to teaching computer science frequently rely on abstract explanations, static diagrams, and text-based materials, which can be difficult for students to comprehend and apply practically. This project will therefore address a new design app that investigates the feasibility of incorporating a smartphone application with augmented reality (AR) technology into computer education, with a particular emphasis on the chosen product of an innovative app, BrainWave. As technology continues to influence our world, it is essential to equip students with the skills and knowledge necessary to effectively navigate the complexities of computing and technology[2]. BrainWave offers an innovative solution by leveraging augmented reality to bridge the divide between theoretical concepts and practical applications.

BrainWave addresses the issue of learning by utilizing augmented reality technology to create an immersive and interactive learning environment. By superimposing virtual computer components and simulations onto the real world, BrainWave enables students to visually investigate and comprehend the intricate inner workings of computers in a manner that cannot be accomplished with conventional methods. Recognising the limitations of conventional approaches to computer education and the growing demand for practical and engaging learning experiences led to the pursuit of this topic.

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[1]Voogt, J. *et al.* (2015) 'Computational thinking in compulsory education: Towards an agenda for research and practice', *Education and Information Technologies*, 20(4), pp. 715–728. Available at: https://doi.org/10.1007/s10639-015-9412-6.

[2]*Computational Thinking in K–12: A Review of the State of the Field - Shuchi Grover, Roy Pea, 2013* (2013). Available at: https://journals.sagepub.com/doi/abs/10.3102/0013189X12463051?journalCode=edra

Design/Development Process

Background Research

The field of computer-oriented education has experienced significant development over the past decade, fuelled by technological advancements and a global transition towards digital literacy. As the prevalence of mobile devices increases, they provide a convenient and accessible platform for delivering educational content. This transition is supported by an increasing corpus of research that recognises mobile learning's potential for enhancing educational opportunity and access and enhancing learning outcomes.

The utilisation of videos and quizzes as educational aids, particularly on mobile platforms, can be highly efficacious in augmenting the learning process and enriching the overall educational encounter. The usage of videos as a mode of instruction is known to be dynamic and engaging, as it has the ability to simplify complex topics and enhance their comprehensibility. Visual formats can effectively demonstrate practical applications and procedures, facilitating learners' comprehension and retention of information. Visual demonstrations are especially advantageous in the realm of computer-oriented education, as it has the ability to elucidate abstract concepts and promote a more profound comprehension of the subject matter (Zhang, Zhou, Briggs, & Nunamaker, 2006)[3].

According to a study by Ally (2009)[4] Mobile learning enables flexible, anytime, anywhere learning, which can be especially advantageous for computer-based education. This enables students to engage with educational content at their own tempo and in their own time, fostering self-directed learning. In addition, the interactive nature of mobile applications can

[3] Zhang, D. *et al.* (2006) 'Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness', *Information & Management*, 43(1), pp. 15–27.
[4] *Zawacki-Richter, O. (2009) 'Mobile Learning: Transforming the Delivery of Education and Training', The International Review of Research in Open and Distributed Learning, 10(4).*

increase motivation and engagement, leading to enhanced information retention (Huang, Lin, & Chuang, 2007)[5].

In contrast, quizzes have the potential to enhance the process of learning and augment the retention of information by promoting active involvement with the subject matter. Prompt feedback is furnished, enabling learners to recognise deficiencies in their comprehension and modify their approaches to learning correspondingly. According to a study conducted by Roediger and Karpicke (2006)[6] consistent testing can improve the long-term retention and application of acquired knowledge. Consolidating knowledge is particularly crucial in the context of mobile learning, as learners may engage in brief learning sessions and require frequent reinforcement to reinforce their understanding.

Besides, the incorporation of videos and quizzes within a mobile platform has the potential to maximize the advantages of learning that can take place at any time and location. According to Crompton's (2013)[7] research, the utilization of mobile learning can enhance the accessibility of educational materials, allowing learners to interact with videos and quizzes at their own convenience. This, in turn, fosters a flexible and self-paced learning atmosphere.

Mobile applications have the potential to offer a more engaging and experiential mode of learning in contrast to conventional classroom-based learning. AR-based mobile applications have the potential to facilitate virtual interaction with computer components, software, and systems in the realm of computer-oriented education, thereby promoting a more profound comprehension of these intricate concepts (Billinghurst & Duenser, 2012)[8].

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[5] *Huang, J., Lin, Y. and Chuang, S. (2007) 'Elucidating user behavior of mobile learning: A perspective of the extended technology acceptance model', The Electronic Library, 25(5), pp. 585–598*

[6] *Test-Enhanced Learning: Taking Memory Tests Improves Long-Term Retention - Henry L. Roediger, Jeffrey D. Karpicke, 2006 (2006).*

[7] *Crompton, H. (2013) 'A Historical Overview of M-Learning: Toward Learner-Centered Education', in Handbook of Mobile Learning. Routledge.*

[8] *Billinghurst, M. and Duenser, A. (2012) 'Augmented Reality in the Classroom', Computer, 45, pp. 56–63.*

Design Process

The development of the BrainWave prototype followed a methodical and repetitive approach, commencing with an examination of prospective concepts on Worksheet 1 (worksheets are stored within the appendix). The emergence of a mobile-based technological learning environment was conceived during the preliminary ideation phase, owing to the identification of a dearth in the market for such educational materials. The concept exhibited a captivating nature and presented substantial possibilities, prompting its subsequent advancement and enhancement in the form of Worksheet 2.

The 2nd worksheet provided an opportunity to further develop the BrainWave concept by incorporating features that would augment its attractiveness and efficacy as an educational aid. At this location, the proposition of a fusion between conventional and modern pedagogical approaches was initially put forward. Acknowledging the efficacy of established pedagogical approaches, it was determined that integrating elements such as gamification and assessments, which have been demonstrated to enhance involvement and consolidate comprehension, would be advantageous. Simultaneously, advanced technology was utilized to offer a more engaging and experiential educational encounter. The selection of Augmented Reality (AR) technology was based on its capacity to convert abstract ideas into tangible and interactive encounters, which enhances the accessibility and engagement of learners with complex subjects.

The design choices were significantly impacted by thorough preliminary research, which highlighted the efficacy of the chosen educational aids such as quizzes, videos, tutorials, and augmented reality technology, in augmenting the learning experience. It also supported the use of gamification, a process in which elements such as points, badges, and leaderboards, have been used in order to foster motivation and engagement, thereby enhancing learning outcomes (Hamari, Koivisto, & Sarsa, 2014)[9].

[9] Hamari, J., Koivisto, J. and Sarsa, H. (2014) 'Does Gamification Work? – A Literature Review of Empirical Studies on Gamification', in *2014 47th Hawaii International Conference on System Sciences*. *2014 47th Hawaii International Conference on System Sciences*, pp. 3025–3034.

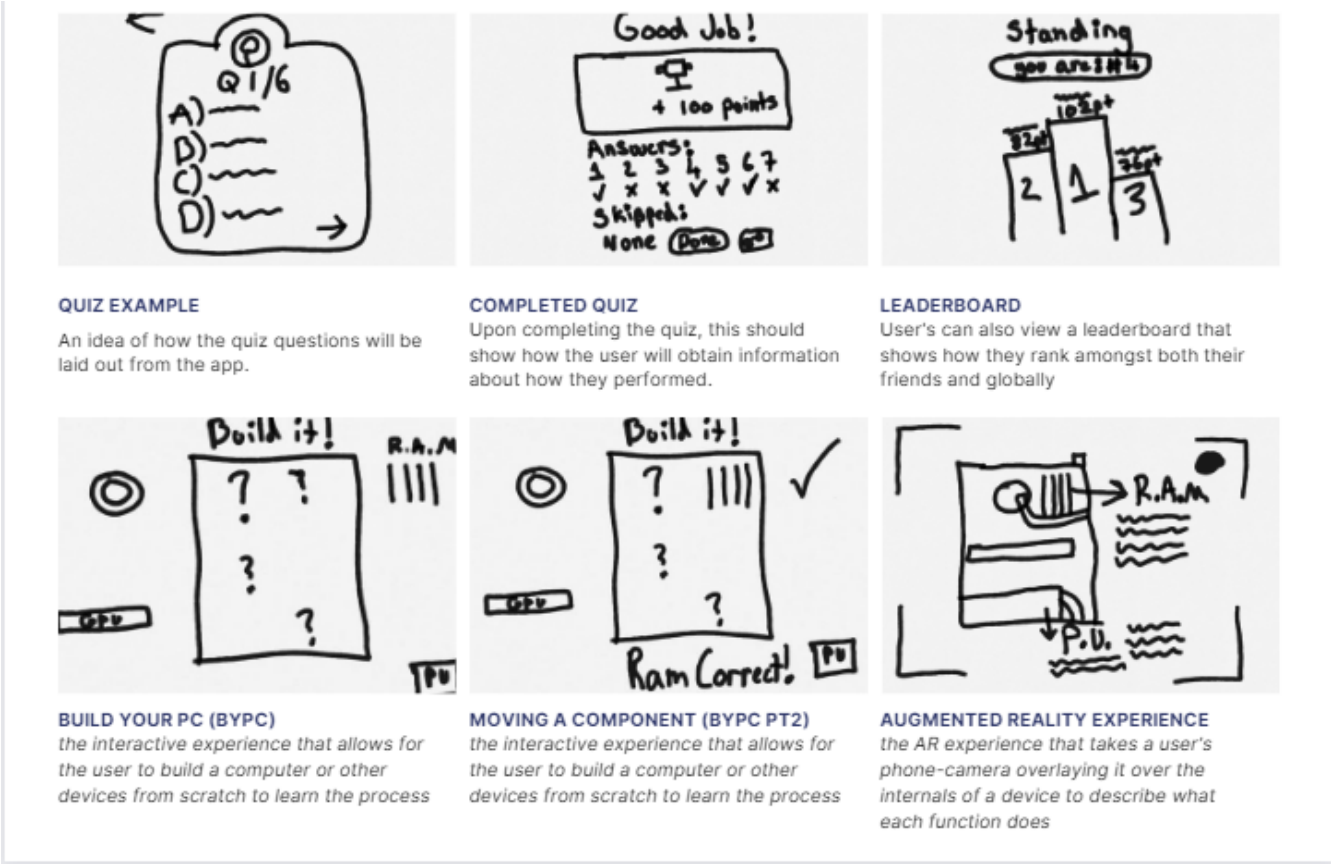
Upon identification of the central concept and the specific issue at hand, which pertained to the insufficiency of accessible and straightforward means for self-directed learning in technology education beyond formal contexts, the subsequent phase entailed the development of a persona in order to gain enhanced insight into the prospective users of BrainWave. The aforementioned was recorded in Worksheet 3, wherein Katherine, a hypothetical character created to embody the type of person who could potentially derive advantages from the application, was introduced.

Katherine, an enthusiastic scholar with a yearning to broaden her understanding of technology, embodies the obstacles encountered by numerous individuals. The individual is facing a challenge regarding the limited availability of practical experiences to enhance their comprehension of technology, specifically within the field of computing. Similar to numerous individuals, she encounters challenges in comprehending advanced computer concepts solely through theoretical instruction. The incorporation of visual and interactive elements pertaining to the fundamental principles of machinery has the potential to greatly augment one's comprehension and educational encounter. The development of BrainWave's features was informed by the creation of a persona, which played a crucial role in the design process by providing a user-centered perspective. The purpose of this measure was to guarantee that the application was not solely inventive and pedagogically beneficial, but also specifically tailored to the requirements and inclinations of its intended user base.

Subsequent to the establishment of the persona, the subsequent stage of the design process entailed the depiction of the user experience via a storyboard, as exemplified in Worksheet 5. Although the initial storyboard may have lacked refinement, it played a crucial role in visualising and developing the structure and purpose of the ultimate outcome.

The utilisation of a storyboard facilitated the visualization of potential user interactions with BrainWave, exemplified by the hypothetical user Katherine. The application provided guidance throughout the diverse phases of the user experience, commencing with the initial

interaction and progressing towards the exploration of distinct functionalities, culminating in the attainment of the educational objectives. The aforementioned process facilitated the identification of prospective obstacles and prospects, thereby providing valuable insights for the conceptualization and construction of the application.



Storyboard: *Rough guideline to interactivity*

Development with Feedback

The BrainWave prototype's development and improvement were greatly aided by feedback. A basic prototype was first created as a paper flipbook based on the storyline. This provided a solid foundation upon which the app might grow. Despite being mostly good, the input from this version brought to light a few important design flaws that needed to be fixed. As mentioned in Worksheet 6, one of the key issues was the app's cluttered user interface and excessive number of pages. This criticism indicated that the software was more complex than it needed to be, which might have overwhelmed users and created visual clutter. The intricacy was not improving the user experience, but rather taking away from it.

The assessment that the app looked excessively ambitious in its incorporation of several functions was another insightful piece of criticism. Although ambition may be a strength, in this case, it ran the danger of overwhelming consumers and complicating the design of the app. The features offered by the BrainWave app were reevaluated in response to your input.

As a result, it was decided to temporarily withdraw the tutorials. This was done to see whether the other features—videos, tests, games, and the AR experience—could successfully convey the same amount of information. This modification made it possible to develop the app in a more simplified and concentrated manner, ensuring that each element significantly enhanced the overall learning process without being too complicated or cluttered.

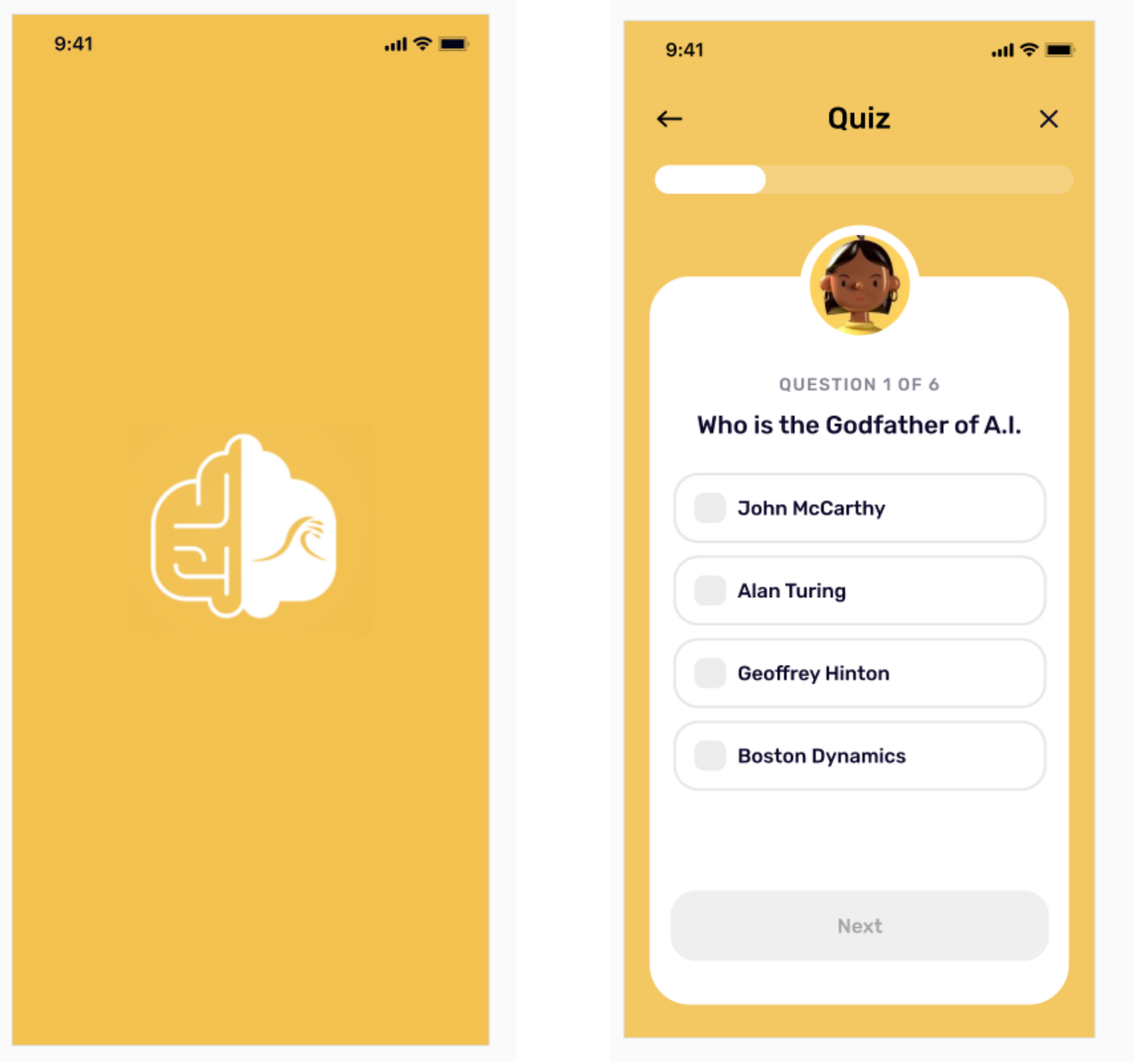
Final Prototype

Link: https://xd.adobe.com/view/efff137a-37c8-4b9e-86fa-96038528f9c0-baac/

In conclusion, the BrainWave final prototype, which represents the project's climax, may be accessed through the product URL mentioned above. This prototype successfully combines the information gleaned from the spreadsheets mentioned in the appendix, resulting in a visually appealing and useful design. Users may easily explore the many features and settings accessible thanks to the smooth navigation experience it offers. For example, as seen in the prototype screenshot below, the difference between the final product and storyboard is immensely different, using the feedback in UX/UI changes to allow for a more streamlined and purposeful design (despite how rough the storyboard actually was).

The prototype uses a yellow colour scheme for aesthetic purposes. Yellow was deliberately chosen because studies have shown that colour may stimulate sentiments of warmth, joy, and friendliness, making the application appear more appealing (Mahnke, 1996)[10]. By supporting the goal of making learning entertaining and accessible, this decision improves the user experience even more. The BrainWave prototype's ultimate goal is to provide a fresh and interesting method to learn about technology while showcasing the possibilities of fusing cutting-edge technology with educational philosophies to improve learning results.

[10] Color, Environment, and Human Response: An Interdisciplinary Understanding ... - Frank H. Mahnke - Google Books (1996). Available at: https://books.google.co.uk/books?hl=en&lr=&id=fAsm_3cXISAC&oi=fnd&pg=PP13&dq=Mahnke,+1996&ots=2u921hS5FY&sig=9I7yBZx0lvuXi7EpHwjK0BHQ20A&redir_esc=y#v=onepage&q=Mahnke%2C%201996&f=false



Prototype: *Custom App Loading Screen Logo & Quiz Example*

Theoretical to Implementation

BrainWave's prototype and design were predominantly influenced by two learning and motivation theories: constructivism and experiential learning. A fundamental principle of constructivism is that knowledge is not passively transmitted from teacher to student, but rather actively constructed in the student's consciousness[11]. It emphasizes the significance of active learner participation in the learning process. BrainWave exemplifies this principle by providing learners with interactive, hands-on experiences that facilitate knowledge construction. For instance, the 'Build Your Own Computer' feature provides more than just information about computer components. Instead, it provides a game-like environment in which students virtually construct a computer by placing each component in its designated location. Learners construct a mental model of a computer system through this active engagement, comprehending not only what the system's components are, but also how they fit together to make the system function.

In addition, BrainWave's augmented reality feature enables users to virtually dissect and investigate their own devices. This interactive exploration goes beyond rote memorization of device components, allowing users to construct a deeper comprehension of how their devices operate.

Second, although cognitive and behaviorist theories are mentioned in the learning journal, I would proceed to characterize the prototype as experiential. Kolb's (1984) Experiential Learning Theory emphasizes the significance of experience in the learning process and the capacity to learn through doing[12]. BrainWave embodies this strategy by immersing users in a learning environment that facilitates experiential and reflective learning. BrainWave's 'Build Your Own Computer' feature is an excellent example of Experiential Learning. Users actively engage in the process of assembling a virtual computer, acquiring first-hand knowledge of the various

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[11] Bruning, R.H., Schraw, G.J. and Ronning, R.R. (1999) *Cognitive Psychology and Instruction. Third Edition*. Prentice-Hall, Inc.

[12] 'Kolb's Learning Styles and Experiential Learning Cycle' (2022), 3 November. Available at: https://www.simplypsychology.org/learning-kolb.html

components and their interrelationships. This activity does not simply provide users with pre-digested information; rather, it creates a situation in which users gain experience through actual participation. After the virtual assembly has concluded, participants can ruminate on their experience. They are able to revisit each stage of the assembly process, observe the virtual components, and reflect on how these components come together to form a functional system.

BrainWave's videos and tutorials facilitate visual and interactive learning. They are designed to immerse users in simulated real-world scenarios in which they can observe, comprehend, and then apply the concepts they learn. A tutorial on ethical hacking could, for instance, simulate a hacking scenario in which users actively partake and make decisions, allowing them to experience the process firsthand.

Elements of gamification, such as points, certificates, and leaderboards, further improve the experiential learning environment by encouraging a spirit of competition and accomplishment. They encourage users to immerse themselves in the learning materials and experiment with various strategies to improve their scores. Not only do they acquire a deeper understanding of the topic, but they also experience the real-world consequences of their actions and decisions. Offering opportunities for active experimentation and reflective observation, quizzes are an essential component of the experiential learning cycle. They allow users to employ their knowledge and skills in new contexts, thereby challenging their comprehension and encouraging them to reflect on their learning process. When users provide an incorrect response, they reflect on their understanding, review the learning materials, and attempt the query again. This process of trial and error fosters a profound, experiential understanding of the subject matter at hand.

BrainWave features essentially create an interactive learning environment in which users can experience, reflect upon, and experiment with the concepts they are studying. As a result, they exemplify both the principles of Experiential Learning Theory and a Constructivist

approach by cultivating a profound experiential understanding that goes beyond mere memorization.

Innovation

The prototype displays a fluid and dynamic application that exhibits how to navigate the available resources. Through research produced within the background section, it was noticed that Brainwave is one of the first of its kind that allows for this type of information on computers to be accessed on a mobile/app platform. While many apps regarding programming already exist, there are none that cover the fundamentals of computer design/technology themselves. Besides providing a unique UI/UX design, and conventional design of resources like: videos, quizzes, games etc, one of BrainWave's many distinguishing characteristics is its use of Augmented Reality (AR) technology. This project has enabled a thorough illustration of how this technology will enable users to interact with virtual components and systems, despite the fact that the prototype does not demonstrate the AR features in action. This innovative form of interaction significantly deviates from conventional learning techniques, engaging users in a more tactile and visual method of comprehending complex ideas. This technology is not only innovative in terms of its hardware, but also in the manner in which it modifies interaction dynamics, thereby making the learning process more immersive and intuitive. In addition, BrainWave's 'Build Your Own Computer' feature offers an innovative method to learn about computer hardware. It provides users with hands-on experience in computer assembly, which is typically reserved for hardware-specific courses or self-taught enthusiasts. This gamified approach enhances the learning experience by enabling users to comprehend the function and significance of each component in an entertaining and engaging manner.

Compared to conventional learning methods, BrainWave is a quantum stride forward. Traditional methods frequently rely on abstract ideas and lack the physicality and relevance that BrainWave provides. By incorporating augmented reality (AR) technology and interactive gaming elements, BrainWave brings learning to life, fostering a deeper understanding and greater retention of information. It enables users to literally visualize and manipulate the concepts they

are studying, making difficult subjects more digestible and less intimidating. It could be believed that this approach provides a significantly more engaging, effective, and pleasurable learning experience than conventional methods.

Evaluation

I am exceedingly delighted with BrainWave's final prototype. I am confident that this innovative application has accomplished its primary objective, which was to create a fluid, user-friendly learning environment for individuals seeking to expand their understanding of computer systems. The seamless incorporation of engaging videos, interactive quizzes, and gamified learning experiences produces an informative and pleasurable educational platform. However, it is essential to observe that the current Adobe XD prototype only represents a small portion of BrainWave's potential. While it effectively demonstrates the application's fundamental functionalities and user interface, it does not completely demonstrate the immersive augmented reality features that distinguish BrainWave. Furthermore, given another opportunity, I would expand on the prototype to show a demonstration of how articles or tutorial videos could be represented on the platform.

Given the chance and the appropriate technology, I would hope to recreate a prototype that embodies the entire spectrum of augmented reality (AR) capabilities. I believe that observing these features in action, such as virtually dissecting a device or constructing a computer in augmented reality, will demonstrate BrainWave's transformative potential. Despite the limitations of the current prototype, I am optimistic about BrainWave's current state and potential to revolutionize computer system education, allowing for a much easier access environment to study from.

References

[1] Zawacki-Richter, O. (2009) 'Mobile Learning: Transforming the Delivery of Education and Training', The International Review of Research in Open and Distributed Learning, 10(4). Available at: https://doi.org/10.19173/irrodl.v10i4.751. (Accessed: 1 May 2023).

[2] Computational Thinking in K–12: A Review of the State of the Field - Shuchi Grover, Roy Pea, 2013 (2013). Available at: https://journals.sagepub.com/doi/abs/10.3102/0013189X12463051?journalCode=edra (Accessed: 1 May 2023).

[3] Harris, K.R. and Alexander, P.A. (1998) 'Integrated, Constructivist Education: Challenge and Reality', Educational Psychology Review, 10(2), pp. 115–127. Available at: https://doi.org/10.1023/A:1022169018926. (Accessed: 1 May 2023).

[4] Mobile Learning via Educational Apps | Proceedings of the 2019 5th International Conference on Education and Training Technologies (no date). Available at: https://dl.acm.org/doi/abs/10.1145/3337682.3337687 (Accessed: 2 May 2023).

[5] Hussain, A., Mkpojiogu, E. and Babalola, E. (2020) Using Mobile Educational Apps to Foster Work and Play in Learning: A Systematic Review. International Association of Online Engineering, pp. 178–194. Available at: https://www.learntechlib.org/p/218344/ (Accessed: 2 May 2023).

[6] Huang, J., Lin, Y. and Chuang, S. (2007) 'Elucidating user behavior of mobile learning: A perspective of the extended technology acceptance model', The Electronic Library, 25(5), pp. 585–598. Available at: https://doi.org/10.1108/02640470710829569. (Accessed: 3 May 2023).

[7] Joplin, L. (1981) 'On Defining Experiential Education', Journal of Experiential Education, 4(1), pp. 17–20. Available at: https://doi.org/10.1177/105382598100400104. (Accessed: 5 May 2023).

[8] Zhang, D. et al. (2006) 'Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness', Information & Management, 43(1), pp. 15–27. Available at: https://doi.org/10.1016/j.im.2005.01.004. (Accessed: 5 May 2023).

[9] Billinghurst, M. and Duenser, A. (2012) 'Augmented Reality in the Classroom', Computer, 45, pp. 56–63. Available at: https://doi.org/10.1109/MC.2012.111. (Accessed: 5 May 2023).

[10] Crompton, H. (2013) 'A Historical Overview of M-Learning: Toward Learner-Centered Education', in Handbook of Mobile Learning. Routledge. (Accessed: 6 May 2023).

[11] Hamari, J., Koivisto, J. and Sarsa, H. (2014) 'Does Gamification Work? – A Literature Review of Empirical Studies on Gamification', in 2014 47th Hawaii International Conference on System Sciences. 2014 47th Hawaii International Conference on System Sciences, pp. 3025–3034. Available at: https://doi.org/10.1109/HICSS.2014.377. (Accessed: 6 May 2023).

[12]Test-Enhanced Learning: Taking Memory Tests Improves Long-Term Retention - Henry L. Roediger, Jeffrey D. Karpicke, 2006 (2006). Available at: https://journals.sagepub.com/doi/abs/10.1111/j.1467-9280.2006.01693.x?journalCode=pssa (Accessed: 7 May 2023).

[13] Voogt, J. et al. (2015) 'Computational thinking in compulsory education: Towards an agenda for research and practice', Education and Information Technologies, 20(4), pp. 715–728. Available at: https://doi.org/10.1007/s10639-015-9412-6. (Accessed: 8 May 2023).

[14] Color, Environment, and Human Response: An Interdisciplinary Understanding ... - Frank H. Mahnke - Google Books (1996). Available at: https://books.google.co.uk/books?hl=en&lr=&id=fAsm_3cXISAC&oi=fnd&pg=PP13&dq=Mahnke,+1996&ots=2u921hS5FY&sig=9I7yBZx0lvuXi7EpHwjK0BHQ20A&redir_esc=y#v=onepage&q=Mahnke%2C%201996&f=false (Accessed: 11 May 2023).

Appendix

Worksheet 1 - Ideas

Week 2 Practical activity: brainstorming	
What? **(topic / target audience / context)**	**Why?** **(what is interesting about this idea)**
Topic: Creative App / An A.I. teaching tool for new painters/artists Target: (Younger) Adults but children as well Context: Used for a combination of both education and recreation.	Painting and artistry is a difficult subject for certain individuals to get started in. Which is why it could be useful to create an app or VR tool to aid people in getting started.
Topic: Teaching people to train their body for archery. Target: Archers / New beginners Context: As an archer, proper form can be hard to learn	Lots of new beginners in the field normally have a hard time learning form which can be vastly impactful in the world of archery. Using AR tools with physical props like a strength band, could help users learn how to do archery
Topic: Teaching users about technology and subjects in theory surrounding it Target: Those looking to get into a tech field	Technology has been an ever growing market, many people of which have found themselves reskilling over to the side of IT-based

Context: Lots of users are either looking to reskill or get into the tech field but there are limited options from an app basis.	
Topic: Offer methods of improving memory Target: Anyone who wants to improve their memory skills Context: gamification through methods like VR/AR	Because of advancements in tech, people have found it easier to just refer to technology as opposed to taking time to learn material, but providing methods of improving memories via games, it could help people.
Topic:An AI grading tool that allows teachers to grade less, and prepare content for classes more Target: teachers Context: AI learning grading system	By using an AI grading system, it could allow teachers to spend less time that could be spent on teaching material, on grading instead. It generally servers to cut down the time that could be spent being efficient.
Topic: Online podcast/skill teaching platform or app Target: Anyone that wants to learn a new skill Context: Videos & Podcasts	A platform that could provide skills from anywhere to do with something technical like photoshop or aftereffects, to maybe practical such as learning the guitar. It allows people to just expand their repertoire.

Worksheet 2 - Developing an Idea

Week 3 Practical activity: Understanding the context of use	
Question	**Response**
What is the topic?	Learning Platform - Allowing users to learn more about the background of computer technology and less about more technical elements like programming languages.
In what settings is the topic taught?	Either in an educational institution, something a lot more academic or online as opposed to something condensed and readily available.
How is the topic currently taught?	Usually within in a classroom, or course videos online
What are the problems with the way the topic is currently taught?	It might be hard for an older generation to access as easily
Who is the audience for the topic?	Anyone that is looking for a switch to the tech field and needs to get a better understanding of computers, or pre-existing computer scientists, that want to reinforce what they may have already understood.
What are their general characteristics?	Teens to Young/older adults, either a lack of knowledge in understanding tech based

	hardware or a bit more experienced. Not entirely useful for those with a massive knowledge in the subject, but still could be used by them to ensure that skills are maintained.
What is their prior knowledge of the topic?	Mentioned above ^
What are their motivations for learning the topic?	They are hoping to pursue a career or generally improve their knowledge of computers to allow themselves to be more individual if they need to perform tasks like removing or replacing hardware, undertaking software projects etc.

Worksheet 3 - Persona

Name: Katherine Langford

Age: 27

Location: Brighton, UK

Background: Katherine Langford, age 27, is a college student majoring in computer science. They aspire to pursue a career in software engineering and have a passion for technology. She possesses a solid foundation in fundamental computer skills, but feels the need to expand their comprehension of the inner workings of computers and acquire practical experience.

Normal Practices:

1. Although Katherine has a theoretical understanding of computer components and software, they lack practical expertise. They have difficulty visualizing how these components interact and connect in actual situations.
2. Katherine frequently uses online tutorials, forums, and YouTube videos to gain knowledge about computing and technology. However, these resources are frequently fragmented, lack interactivity, and do not offer an exhaustive learning path.

Motivations:

1. Katherine is looking for an immersive and compelling learning experience. They believe that visual and interactive elements can strengthen their comprehension of complex concepts and enhance their learning outcomes overall.
2. She is motivated to acquire practical skills that correspond to their career objectives. They desire a deeper understanding of how computers function, from the motherboard to the CPU, RAM, and storage, in order to confidently construct and troubleshoot systems.

Frustrations:

1. The limited opportunities for hands-on practice frustrate her. They are aware that practical experience is necessary for acquiring the skills necessary for their intended career path.
2. Katherine struggles to fathom sophisticated computer concepts from text or diagrams alone. They frequently experience frustration because the abstract nature of traditional learning methods hinders their ability to visualize and comprehend the subject matter.
3. Katherine occasionally has difficulty studying alone. They desire a sense of community in which they can connect with like-minded individuals, seek advice, and engage in substantive conversations.

Worksheet 4 - Specifying User Requirements

Question	Response
What technology have you selected to use?	The chosen technology for the proposed product is a combination of a learning smartphone app and augmented reality (AR) elements. This application employs augmented reality technology to provide users with a visual exploration of the interior workings of computers.
If there is no change in technology between current teaching methods and your proposal (e.g. desktop in both) then what is the innovation?	The application employs augmented reality technology to allow users to visually investigate the interior workings of computers. The app allows users to aim their phone's camera at their own devices or predefined computer models, and overlays interactive augmented reality (AR) elements to demonstrate how various components interact. Users can view how data flows through the motherboard, CPU, RAM, and storage devices, for instance.
Why do you think this technology / innovation will improve on the way things are currently taught?	Traditional methods of teaching computer and technology concepts frequently rely on textbooks, lectures, and static images, which can be difficult for many students to comprehend. By incorporating AR technology, this app provides interactive and visually immersive experiences that bring these concepts to life. This increases engagement and improves the enjoyment and retention of learning. Users can access

	the application at any time and location, making learning convenient. Whether they have a few minutes or several hours to devote, they can study at their own tempo. In addition, offline access enables users to continue learning without an internet connection, making the platform accessible to those with limited connectivity.

Brief:

This report describes the design process for a Technology-Enhanced Learning Environment (TELE) in the form of a novel smartphone application called Brainwave, which seeks to provide users with a solid foundation in computer-based technology before they take the steps needed to enhance their newly found knowledge.

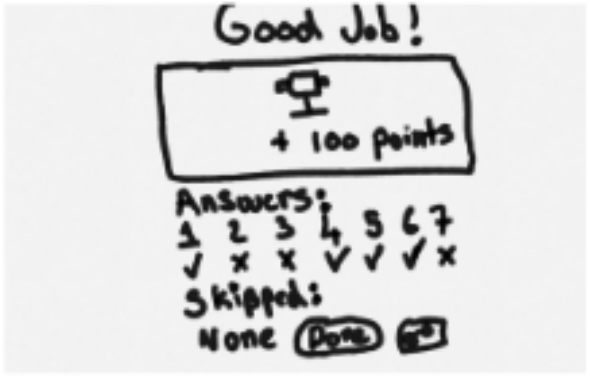
Katherine desires to use the BrainWave software because she has a strong interest in technology and a desire to increase her computer literacy. Traditional learning methods, such as textbooks and online tutorials, do not provide a visual and interactive experience, which frustrates her. Katherine's desire to pursue a career in software engineering and her need for practical skills and knowledge are the sources of her motivation. This app's augmented reality technology promises to bring the interior workings of computers to life, enabling her to visually investigate and comprehend complex concepts. In addition, Katherine's desire for a structured curriculum and a supportive learning environment is met by BrainWave's personalised learning paths and community interaction features. BrainWave is ultimately an engaging and immersive platform that satisfies Katherine's need for hands-on experience, visualisation, and an in-depth comprehension of computing and technology.

Katherine excitedly launches the BrainWave app on their smartphone, keen to explore the realm of computer technology. They navigate to the "Hardware Basics" module, which discusses the basic components of a computer system. The application detects the AR markers in the room, identifies Katherine's computer, and displays a virtual representation of it on the screen. With the augmented reality technology activated, Katherine aims the camera on their smartphone at the computer. BrainWave overlays virtual components on a physical device instantaneously. The motherboard appears with slots for the CPU, RAM, and expansion devices that are labelled. As they rotate the virtual model and observe how the components join together, Katherine is captivated. Katherine, eager to acquire practical expertise, selects the "Build Your Own Computer" activity. The application provides a virtual workstation for component assembly. Katherine follows the detailed instructions by dragging and placing virtual components into position. The application provides real-time feedback to ensure that components are aligned and connected properly. Katherine completes the module and earns a badge in recognition of their accomplishment. They decide to share their progress with the BrainWave community by uploading a screenshot of their virtual computer assembly and problem-solving accomplishments. They receive encouraging comments and suggestions from fellow students almost immediately, spurring engaging discussions.

Worksheet 5 - Storyboard

QUIZ EXAMPLE

An idea of how the quiz questions will be laid out from the app.

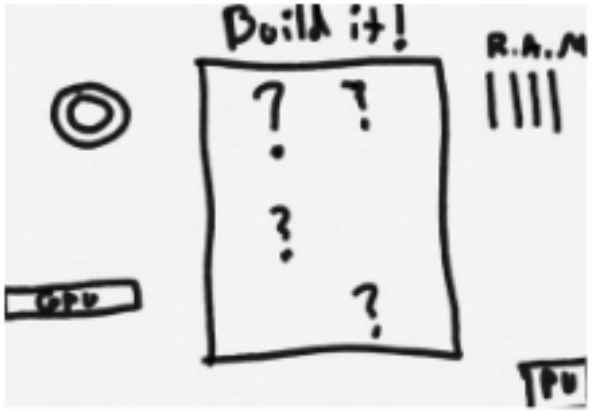


COMPLETED QUIZ

Upon completing the quiz, this should show how the user will obtain information about how they performed.

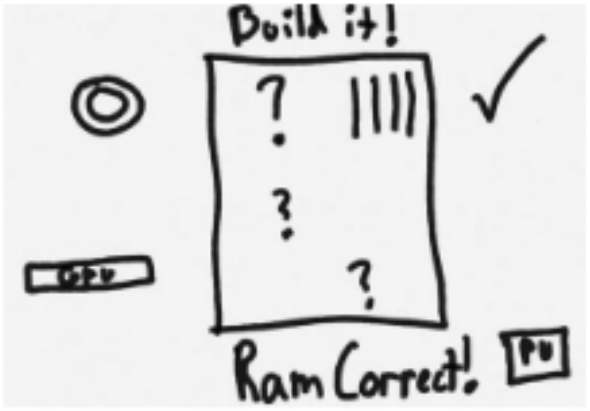
LEADERBOARD

User's can also view a leaderboard that shows how they rank amongst both their friends and globally



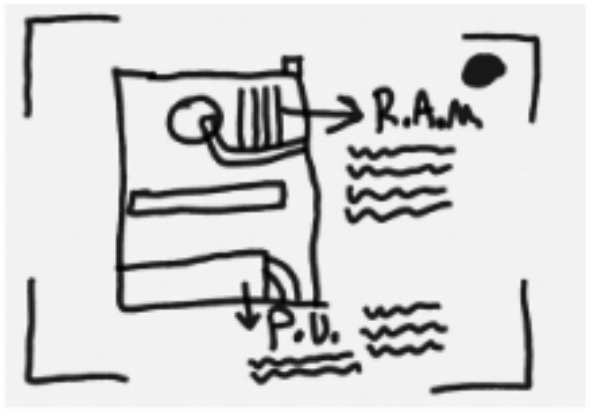
BUILD YOUR PC (BYPC)

the interactive experience that allows for the user to build a computer or other devices from scratch to learn the process



MOVING A COMPONENT (BYPC PT2)

the interactive experience that allows for the user to build a computer or other devices from scratch to learn the process



AUGMENTED REALITY EXPERIENCE

the AR experience that takes a user's phone-camera overlaying it over the internals of a device to describe what each function does

Worksheet 6 - Feedback

Feedback Requested (designs/ideas you wish to get feedback on)	**Feedback Received** (include as much detail as possible)	**Action to Take** (how you could respond)
How might I look to design the application for an IOS device for instance?	Look to get inspiration from an app like duolingo, an app used for linguistics.	Studying the app of Duolingo, and how they convey information to the user as well as their methods of gamification and how I could draw inspiration to adapt my own ideas.
Would a UI like this work for my app (showing off a potential idea of how the app could look)	Looks quite cluttered, a lot of information on the screen when there doesn't need to be	Take off and remove some elements and spread them to other pages where needed.
What information would seem to be not as useful as the rest?	The tutorials don't really serve a purpose, there isn't any real need for them	Either remove them entirely, or refactor them into any of the remaining elements
What other forms of gamification should I use to get people motivated to use my app?	Maybe leaderboards, people love competing with their friends	Implement a social tab/leaderboard system so people are motivated to challenge their friends

Survey Answers

Questions:

1. Age
2. How interested are you in technology/computers?
3. Are you taking a tech-based subject?
4. Do you normally have to watch videos to learn more about tech?
5. Would you take online courses/tutorials for computer-based skills?
6. Would you use an App instead for online courses/tutorials?
7. Would you be willing to pay for it? Or want it to be free?
8. What are your favorite learning methods? (Games, Videos, Tutorials, Quizzes etc.)
9. Does the idea of Augmented reality learning interest you?
10. What would make you more inclined to use a learning app? (friend/social features, leaderboards. etc?)

Respondent 1:

Q	Answer
1	22
2	Quite
3	yes
4	yes
5	depends what the topic is on
6	i would
7	be free ofc
8	games
9	I don’t particularly mind it

10	a social friends thing, i'm very compeittive

Respondent 2:

Q	Answer
1	21
2	extremely
3	yes
4	all the time
5	If i have the time, maybe
6	Yeah, i use some already
7	free
8	videos
9	Sounds cool sure
10	Reward system, or at least badges or acihevements

Respondent 3:

Q	Answer
1	21
2	Pretty interested
3	yeah
4	yes
5	Yeh, i've taken courses before
6	sure
7	free
8	games
9	yes
10	Rewards for completing stuff

Respondent 4:

Q	Answer
1	23
2	Quite alot !
3	Yes !
4	yes
5	Yes, i used youtube and lynda before
6	I love apps instead of websites
7	Free, maybe a very small fee
8	Games and tutorials
9	yes

10	leaderboard

Respondent 5:

Q	Answer
1	22
2	enough
3	ya
4	Yeah i watch alot of software videos
5	yes
6	yes
7	free
8	Games, quizzes are okay but a bit boring
9	Meh, i don’t use it much
10	badges